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Shock Threat and Sexual Arousal: The Role of Selective Attention, Thought Content, and Affective States

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ABSTRACT

In an attempt to detail cognitive processes during anxiety and sexual arousal, 16 heterosexual males were presented with brief erotic audiotapes simultaneous with four levels of shock threat (no shock, half tolerance, tolerance, and twice tolerance threat). Subjects were instructed to pay close attention to the audiotapes, following which a sentence recognition task was administered to assess stimulus-focused attention. Additionally at these times, they were given a thought-listing task and completed a series of affect ratings. Tumescence and subjective arousal were monitored continuously during the erotic stimuli. Results revealed that tolerance shock threat decreased tumescence ($p<.05$). In contrast, recognition memory was greatest during tolerance shock threat and diminished during twice tolerance shock threat, which also produced increased reports of emotional states. Issues regarding the relation between cognition and sexual arousal are discussed, including implications for understanding sexual dysfunction.

DESCRIPTORS: Sexual arousal, Anxiety, Attention.

The clinical literature on sexual dysfunction is replete with observations concerning the role of performance anxiety as a maintaining factor. Close examination of these accounts (e.g., Kaplan, 1981; Masters & Johnson, 1970; Zilbergeld, 1978) reveals a wide range of definitions of specific fear-related processes. For example, Kaplan (1981) emphasizes individual vulnerability to stress as a key factor maintaining impotency, while Masters and Johnson (1970) emphasize specific performance concerns. Additionally, the process through which anxiety interrupts the sexual arousal response is frequently unspecified in these reports, creating conceptual confusion over the cause and effect relationship between anxiety and sexual arousal (Beck & Barlow, 1984).

In contrast with the clinical literature, empirical examinations of the effect of anxiety on sexual arousal have demonstrated somewhat surprising results. As reviewed by Beck and Barlow (1984) and Barlow (1986), a number of studies have reported that experimentally-induced anxiety either facilitates sexual responding or does not affect it. In one of the earliest laboratory reports of this type, Hoon, Wincze, and Hoon (1977) examined the effect of pre-exposure to anxiety-inducing films (scenes of automobile accidents) on subsequent sexual arousal in normal women. Relative to neutral pre-exposure, higher levels of vasocongestion were seen following the anxiety films. Similar results were noted with normal male subjects by Wolchik et al. (1980), using the same experimental paradigm. However, as noted by Wolpe (1978), this paradigm introduces a contrast effect, more specifically the possibility that heightened sexual responding was attributable to anxiety relief.

To address this concern, Barlow, Sakheim, and Beck (1983) utilized a shock threat paradigm with male subjects simultaneous with erotic presentations. Subjects were either told that shock was contingent on achieving adequate arousal, or that shock was noncontingent on any response as they viewed erotic films. Relative to a neutral control condition, higher tumescence was achieved by subjects during both shock threat conditions. Interestingly, no differences were seen in reports of subjective sexual arousal between conditions. The most recent study of this series examined shock threat in conjunction with two types of attentional instructions in sex-

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ually functional and dysfunctional men (Beck & Barlow, 1986a, 1986b). Subjects were instructed to attend either to internal feelings of arousal (sensate focus) or to their degree of tumescence (spectator focus) with and without the presence of shock threat. In contrast with earlier findings, shock threat significantly reduced tumescence for sexually functional subjects, while no effect was noted on sexually dysfunctional subjects' responding. Dysfunctional subjects were more likely to report diminished affective involvement and greater preoccupation with internal thoughts, sensations, and feelings during all experimental conditions, suggesting a distraction process.

In light of the complex nature of this collection of studies, it appears that the concepts of distraction and anxiety are overlapping, when applied to sexual dysfunction (e.g., Adams, Haynes, & Brayer, 1985; Farkas, Sine, & Evans, 1979; Geer & Fuhr, 1976). Possibly, the nature of sexual performance anxiety as discussed in the clinical literature is analogous to the attentional disruption noted in social and evaluation anxiety. Related research has indicated that in test anxiety, the individual's attention is directed away from relevant environmental cues (e.g., an examination) and focused on thoughts of perceived inadequacies and prospective negative outcomes (Doris & Sarason, 1955; Pilkonis, 1977; Sarason, 1982; Sarason & Stoops, 1978). A similar type of process may be operative in erectile dysfunction, although no empirical data exist on this issue (Beck & Barlow, 1984).

The purpose of this study was to provide a preliminary empirical analysis of cognitive processes during four levels of shock threat and sexual arousal. As initially suggested by Geer and Fuhr (1976), the field of cognitive psychology offers many paradigms for the study of mental processes such as directed attention, memory, and stimulus detection, which could reveal important information concerning relevant cognitive processes in anxiety and sexual arousal (e.g., Lansky & Wilson, 1981). Of particular relevance to this issue are approaches to the study of human memory (e.g., Craik & Lockhart, 1972; Norman & Rumelhart, 1975), which have emphasized that intermediate- and long-term memory results when external events are actively processed by an individual (e.g., Craik & Tulving, 1975). Thus, the use of four levels of shock threat in the present investigation allowed for examination of attentional processes during varying levels of anxiety.

Additionally, without exploring both thought content and attentional processes, it is difficult to establish the nature of cognitive processes during shock threat and sexual arousal. Thus, the present investigation was designed to assess both thought content and stimulus-directed attention using the shock threat paradigm of Barlow et al. (1983) as a means of experimentally manipulating anxiety. Four levels of shock threat were employed to explore varying intensity levels of the anxiety manipulation (no shock, half tolerance, tolerance, and twice tolerance shock threat). These instructions were delivered during erotic audiotapes to sexually functionally males, in a repeated measures design.

The use of audiotapes in this study allowed for a refined analysis of stimulus-directed attention using verbal recognition memory. Experimental work in the area of consciousness and attention has revealed that accuracy in recognition depends upon active encoding and retrieval processes (e.g., Jacoby & Craik, 1978) as well as upon focused attention (Treisman, Squire, & Green, 1974). It was hypothesized that recognition accuracy would increase under shock threat instructions, to indicate more focused attention and more active processing of external stimuli. However, at the most elevated level of shock threat (twice tolerance), recognition accuracy was expected to diminish, possibly due to an increase in anxiety-related cognitions.

Method

Subjects

Sixteen, heterosexual (Kinsey rating = 0) males, aged 21–35 ($\overline{X}$=24), served as subjects for the present study. Subjects were paid volunteers, prescreened with an initial interview. All reported normal levels of sexual interest, arousal, and experience on the Derogatis Sexual Function Inventory (Derogatis, 1976) and the Sexual Arousal Inventory (Hoon, Hoon, & Wincze, 1976). Subjects were recruited from a college campus, with announcements of research on shock threat and sexual arousal. None refused participation after being informed of the procedures involved.

Experimental Design

Four levels of shock threat were used in the present study: no shock, half tolerance, tolerance, and twice tolerance threat. Tolerance levels were determined individually during a pre-experimental procedure; no shocks were delivered during the erotic presentations, although signal lights were used to indicate a 60% chance of shock contingent on degree of tumescence. Prior research (Barlow et al., 1983) has indicated that contingent shock threat produces a larger experimental effect, relative to noncontingent shock threat. These four levels of shock threat were selected to create varying degrees of anxiety. Shock instructions were delivered during four matched 2½-min erotic audiotapes in a repeated measures design. The choice of relatively brief stimuli was necessitated by the use of a repeated measures design, to avoid habituation effects. Pairing of shock instructions and stimulus tapes was randomized across subjects, and order of presentation was counterbalanced.

Immediately following each audiotape presentation, a sentence recognition task was administered to assess the degree to which subjects had attended to the preceding tape. Subjects were also given a thought-listing task following each stimulus, to explore thought content. Additionally, subjects were required to complete a series of affect ratings to examine the emotional correlates of anxiety and sexual arousal.

Measures

Physiological. A mechanical strain gauge (Barlow, Becker, Leitenberg, & Agras, 1970) was employed to measure penile circumference, consisting of a strain gauge affixed to a flexible metal ring that expands during tumescence. The subject is instructed to place the device proximal to the coronal ridge on the penile shaft.

Subjective. Subjects were instructed to move a lever continuously throughout each stimulus to indicate subjective arousal. This device was calibrated on a 0–100 scale and was placed next to the subject. Previous work (Wincze, Venditti, Barlow, & Mavissakalian, 1980) has demonstrated that this measure is relatively unobtrusive.

Cognitive. Immediately following stimulus offset, a sentence recognition task was presented, consisting of a 20-item list of sentences. Half of the items were drawn from the text of the preceding stimulus tape and the remaining items were sentences that the subject had not heard. The subject was asked to rate the familiarity of each item on a 1–4 scale (1 = definitely heard the sentence in the tape; 4 = definitely did not hear the sentence in the tape). Order of sentence items was randomized. Sentence recognition items were piloted with a separate sample of subjects to ensure a moderately difficult level of accuracy.

Additionally, subjects completed a thought-listing procedure, following the sentence recognition task. This involved instructions to "list as many thoughts as possible that you can recall thinking during the last tape." Subjects were encouraged to be completely honest and confidentiality of these responses was assured.

Affective. Following the cognitive measures, subjects were asked to rate a series of mood adjectives on a 0–10 scale (0 = not experienced this feeling; 10 = intense experience of this feeling), to indicate their emotional state during the preceding stimulus. Affective items included: anxious, involved, interested, calm, happy, worried, and pleasant, selected from the larger pool of items on the Multiple Affect Adjective Checklist (Zuckerman & Lubin, 1965). Subjects were instructed to "rate these adjectives to indicate how you felt during the last tape."

The two cognitive tasks and the affective ratings were administered immediately after stimulus offset. Subjects first completed the sentence recognition task, followed by thought-listing, and finally, the affective ratings.

Data Sampling and Scoring

Data from the strain gauge and subjective lever were recorded on a Grass Model 7P1 polygraph and simultaneously sampled by an LSI-11 microprocessor. Tumescence data were scored as millimeters circumference change from baseline, based upon pre-session calibration. The use of tumescence change scores was employed to control for the Law of Initial Values (Wilder, 1958). Subjective arousal data were converted to a 0–100 scale. Measures were sampled at a rate of 100 samples/minute with samples averaged to form 15, 10-s epochs for each measure during each condition.

Sentence recognition data were scored using signal detection methodology (Egan, 1975; Green & Swets, 1966). For each stimulus, a 'hit' was scored for each occasion where the subject indicated familiarity with an item (rating of 1 or 2) and was correct; a 'false alarm' was scored when familiarity with an item was rated (rating of 1 or 2) but was incorrect. These values were converted into probability scores by dividing the obtained frequency by the total number possible in each category for each subject. A value of d' (a measure of observer sensitivity) was computed by determining the normalized ratios of these two probabilities. This approach to data scoring controls for bias effects. Higher values of d' indicate more accurate sentence recognition memory.

Thought-listing data were scored by two trained independent raters using a seven category scoring system derived through pilot testing. Categories included: 1) statements about sexual arousal (subjective or physical), 2) statements concerning electrical shock, 3) statements concerning the experimental procedure or setting, 4) repetition of portions of the stimulus tape, 5) statements concerning the quality or mode of stimulus presentation, 6) subject-generated fantasies, and 7) statements mentioning any emotional state other than sexual arousal. This scoring system was able to account for all statements listed by subjects. Interrater agreement was calculated by the following formula: %Agreement/%Agreement+%Disagreement, where an Agreement was defined as both raters coding a thought into one category. By this method, reliability was 80% between the two raters; disagreements were resolved by a third independent rater.

Affect data were averaged across subjects by condition. Because these adjectives had been selected from a more extensive, validated scale, it was not possible to derive summary factor scores for each subject. These data are included as corollary information to the physiological and cognitive measures.

Procedure

Shock Training. After informed consent was obtained, the subject's shock tolerance level was determined, in order to heighten the credibility of shock threat during the experimental session. A spot on the right ventral forearm was cleaned with alcohol and lightly rubbed with sandpaper to minimize skin resistance. Two shock electrodes were secured with a Velcro strap and the subject was informed that he would be receiving increasing shocks until his tolerance level was reached and he indicated this verbally. Shocks of 20-ms duration were administered with a Grass SD-9 stimulator, beginning with a 1.0 mA shock and increasing in 1.5 mA steps on a variable interval sched-

ule to a maximum of 14 mA. Shock parameters were determined following guidelines provided by Grass Instrument Company and Butterfield (1975). This procedure has been described in detail by Barlow et al. (1983) and Beck and Barlow (1986a). Average tolerance level was 8.6 mA and only one subject reached tolerance at the 14.0 mA intensity.

Experimental Session. Each subject participated in one experimental session and was run individually. The subject first placed the strain gauge, following instructions given by the experimenter. The experimenter then explained to the subject that he would be hearing four erotic audiotapes through a speaker. A slide accompanied each audiotape, stating the probability of receiving half tolerance shock, full tolerance shock, twice tolerance shock, or a meaningless control condition that was necessary because the experiment was computer controlled (no shock threat). The subject was instructed that there was a 60% chance of shock *if* his level of arousal was less than the average participant at that point in the stimulus. He also was reminded to complete the cognitive and affective measures after each stimulus. Subjects were informed in advance that their memory for portions of the stimulus tapes would be assessed following each presentation although no association between recognition accuracy and the probability of shock was mentioned.

Four moderately arousing, 2½-min explicit erotic audiotapes were used as stimuli. The tapes had been rated as producing equivalent levels of moderate arousal in heterosexual males in a pilot study. No shocks were delivered during the erotic presentations.

Following the experimental session, each subject was interviewed with a semi-structured interview to check the validity of the experimental manipulation. All subjects had believed the shock threat manipulation, as indicated by estimates provided during debriefing of the probability of shock threat (range 60–85%) in the three shock conditions.

Results

Physiological and Subjective

Data from the strain gauge and the subjective rating lever were analyzed using a repeated measures ANOVA (level of shock (4) × time (15)), after

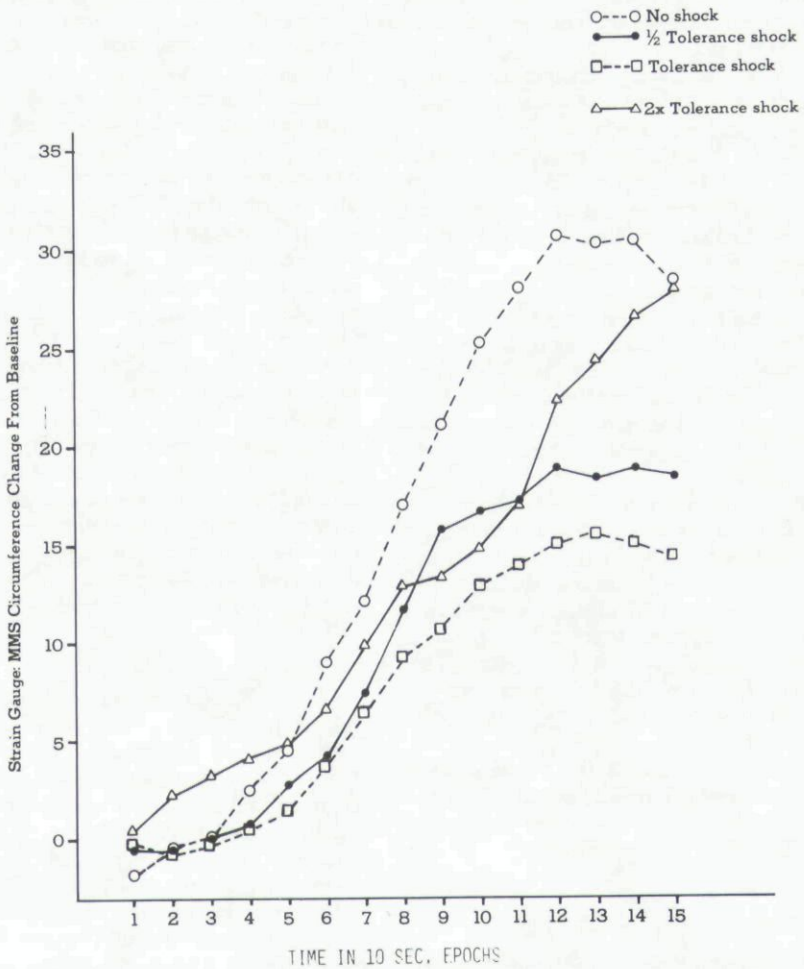

Figure 1. Mean strain gauge responding across subjects by epoch during four shock threat conditions.

tests from compound symmetry revealed that the assumption of equal variance-covariance had not been violated. For strain gauge data, a significant shock threat × time interaction emerged ($F(42/630)=1.45$, $p<.05$). Multiple comparison follow-up tests, using Duncan's procedure, revealed that tumescence under no shock threat instructions was significantly higher than tumescence during tolerance shock threat instructions in the final 50 s (5 epochs) of these stimuli ($p<.05$) (see Figure 1).

A similar repeated measures ANOVA of the subjective lever data did not reveal significant between-condition effects. The correlations between the strain gauge and subjective lever ranged from $r = .65$ to .85, with the highest concordance between these two measures occurring during the no shock control condition and the lowest occurring during half tolerance shock threat. No significant between-condition differences emerged for the correlations.

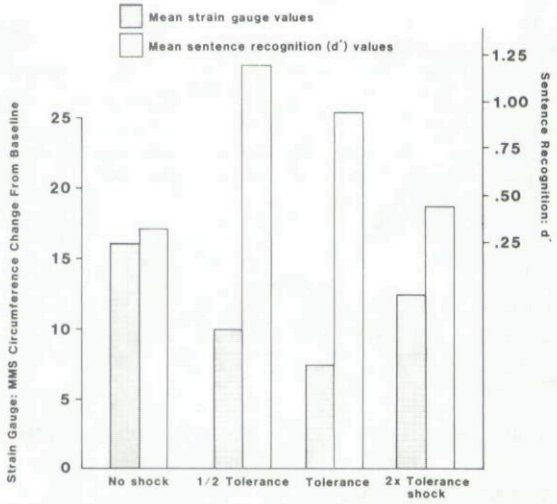

Figure 2. Mean strain gauge responding, averaged across stimulus duration, and mean sentence recognition values during four shock threat conditions.

Cognitive

Sentence recognition data were analyzed with a repeated measures ANOVA, revealing no significant effects ($F(3/45)=2.22$, $p<.09$). Examination of group means indicated that sentence recognition was the most accurate under half tolerance shock threat ($\overline{X}=1.21$), followed by the full tolerance condition ($\overline{X}=0.92$). Recognition during the no shock and twice tolerance threat conditions was substantially less accurate ($\overline{X}$ = 0.29 and 0.48, respectively). These values are plotted in conjunction with mean penile tumescence values in Figure 2. The correlation between maximum tumescence and d' values revealed a negative relationship across conditions: $r =$ .17, −.39, −.39, and .03 during no shock, half tolerance, full tolerance, and twice tolerance conditions respectively.

Thought-listing data were examined with a repeated measures ANOVA (level of shock (4) × thought category (7)) after the data were transformed to percentage scores for each subject, permitting parametric analyses by converting categorical data to a ratio scale (Fleiss, 1981). Tests for compound symmetry indicated that the assumption of equal variance-covariance had not been violated. The results indicated a significant category effect across shock conditions ($F(18/270)=4.56$, $p<.001$). Duncan's follow-up tests for differences between the four shock conditions indicated that subjects reported significantly more repetitions of the stimulus tape during twice tolerance threat, relative to the other three conditions ($p<.05$). Additionally, significantly more subject-generated fantasies were reported during half tolerance threat, relative to the twice tolerance condition ($p<.05$). More statements about nonsexual emotional arousal were reported during twice tolerance threat, relative to no shock threat ($p<.05$). Table 1 reports the average percentage of statements by coding category. As would be expected, subjects reported greater concern over electrical shock with increasing in-

Table 1

Average percentage of reported thoughts by category and condition

Thought Categories	Mean Percentages			
	No Shock	Half Tolerance	Tolerance	Twice Tolerance
Statements about sexual arousal (physical or subjective)	42	39	35	37
Statements about electrical shock	6.5	7.5	16***	12***
Statements about the experimental procedure or setting	6.5	5	0	4
Repetitions of portions of stimulus tape	0	0	2	5*
Statements about mode of presentation	28	26	29	26
Subject-generated sexual fantasies	13	15	9	5**
Statements concerning emotional states other than sexual arousal	4	7.5	9	11***

*Significantly different from other three shock conditions, $p< .05$.
**Significantly different from half-tolerance condition, $p< .05$.
***Significantly different from no shock condition, $p< .05$.

Table 2
Mean affect ratings by condition

Affect Adjectives	Mean Ratings[a]			
	No shock	Half Tolerance	Tolerance	Twice Tolerance
Anxious	2.00	2.56	2.31	3.37
Worried	0.56	0.88	1.25	1.37
Calm	9.68	7.00	6.44	6.63
Interested	6.00	5.00	6.06	5.94
Involved	6.13	5.19	5.44	5.59
Happy	6.06	5.69	5.44	8.37
Pleasant	4.28	3.71	2.75	3.83

[a]Scale 0–10, 10 = maximum.

tensities of shock threat. No substantial changes across conditions occurred in statements concerning sexual arousal.

Affective

Given that the affect adjectives had been selected from a more extensive validated scale, statistical analyses were not possible. However, examination of these ratings collected after each stimulus indicated that subjects reported changes in feelings of anxiety, involvement, interest, happiness, and pleasantness across conditions. These data are presented in Table 2. Ratings of anxiety increased with increasing intensities of shock threat, while ratings of calmness decreased with increasing intensities of threat.

Discussion

The results of the present study reveal that a moderate intensity shock threat reduces penile tumescence, relative to a neutral control condition. More extreme levels of shock threat did not result in diminished tumescence. A trend toward increased recognition accuracy under half tolerance and tolerance shock threat was noted, with diminished recognition accuracy during the most extreme level of shock threat. In contrast with one prior investigation (Barlow et al., 1983), shock threat did not uniformly heighten responding in the current investigation. Rather, the effect of the four levels of shock threat resembled a U-shaped function, reducing arousal at tolerance levels and showing minimal effects at half and twice tolerance levels, relative to the control condition. Examination of individual data revealed that 9 of the 16 subjects demonstrated this pattern. The remaining 7 subjects did not conform to one identifiable pattern, although this may be due to the small sample size.

Given the discrepancy between these findings and the earlier report of Barlow et al. (1983), closer examination of these two studies appears warranted. The present report demonstrates that anxiety can decrease tumescence and is associated with more external attention, whereas Barlow et al. demonstrated the arousal-enhancing properties of anxiety. While both investigations used the same shock threat paradigm to invoke anxiety, several explanations appear possible.

First, the use of audiotapes in the present study may have contributed to the pattern of findings in light of stimulus modality effects in similar investigations (e.g., Abel, Barlow, Blanchard, & Mavissakalian, 1975; Przybyla & Byrne, 1984). Auditory presentations may, for example, facilitate a wider variety of imagery processes (e.g., Byrne, 1977; Lang, 1979; Przybyla, Byrne, & Kelley, 1983) and thus may require more active cognitive processing by subjects, relative to videotape stimuli. If so, this would suggest that sexual arousal is facilitated by diminished task encoding requirements, perhaps implicating the significance of selectivity in information processing during sexual arousal.

Secondly, while stimulus modality effects may partially account for the discrepancy between these findings and Barlow et al. (1983), data similar to the present results have been reported by Beck and Barlow (1986a) using visual stimuli. In this investigation, shock threat diminished tumescence for sexually functional men, much like the results noted during half tolerance and tolerance shock threat. It is possible that the inclusion of additional experimental tasks, such as the assessment of sentence recognition and other manipulations of attentional focus, influences the effects of shock threat on sexual arousal in an unknown fashion. One consistent finding across these three studies, however, is that shock threat did not affect subjective arousal, suggesting that the physiological and subjective sexual response domains are influenced by different mechanisms. Tumescence appears to be affected by factors that create autonomic arousal, while subjective arousal appears to be influenced by cognitive factors. This observation suggests the need for additional refinement in our understanding of individual and interactive influences on the sexual response.

The cognitive measures used in this study provide preliminary data concerning information processing during simultaneous states of anxiety and sexual arousal and offer empirical refinement of the relationship between these variables. Stimulus recognition tended toward greater accuracy during half tolerance and tolerance shock threat, indicating active encoding and more focused attention to external events during these conditions. The increased attention to the stimulus tape that was seen in these conditions was accompanied by diminished levels of interest and involvement as indicated by affect

ratings. Possibly, this suggests a degree of emotional detachment as a consequence of attention directed to the semantic stimulus content, consistent with clinical accounts of anxiety during sexual arousal.

In contrast, twice tolerance shock threat minimally influenced tumescence and relative to the other shock threat conditions, was accompanied by more repetitions of the stimulus, fewer sexual fantasies, and heightened reports of emotional states other than sexual arousal, particularly happiness. In certain respects, the contrast in cognitive responding between twice tolerance threat and the other two shock conditions mirrors the differences noted between sexually functional and dysfunctional men by Beck and Barlow (1986b). Dysfunctional subjects, in this latter study, gave lower affect ratings and reported more descriptions of the erotic films, relative to sexually functional men. While direct comparisons of stimulus encoding in sexually functional and dysfunctional men are not possible, given the design of the present study, it is possible that sexually functional men may be able to balance their allocation of attention between sexual stimuli and internal states, when placed under an extreme demand for performance such as twice tolerance shock threat. Dysfunctional men may not be able to shift their attentional focus in the same manner and appear more preoccupied with self-observation of tumescence (Beck & Barlow, 1986b). Replication of the present investigation with sexually dysfunctional men will help in examining these speculations.

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